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ABSTRACT

This unit is designed to help social studies or science teachers incorporate ecological concepts into the teaching of science and Missouri geography. The unit includes: (1) a topic outline; (2) general unit objectives; (3) an introduction to basic biogeographical concepts; (4) descriptions of the glaciated prairie, unglaciated prairie, ozark, and southeastern lowland biogeographical regions in Missouri (each description providing information on the region's landforms, climate, soils, plants, and animals); (5) lesson plans on the basic biogeography of Missouri and the four regions (each plan consisting of a list of materials needed, a list of objectives, and instructional strategies); (6) glossary; (7) list of references; and (8) appendices. The appendices include overhead transparency masters, a list of Basic Essential Skills Test objectives (for mathematics and reading/language arts) covered by the unit, and unit test (with answers). (JN)

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Instructional Unit

BIOGEOGRAPHY OF MISSOURI

By

David A. Castillon, Ph.D.
Geomorphologist
Southwest Missouri State University

Lesson Plans by Connie Harrison

Cover and Illustrations by LuAnne Barkhaus

Missouri Department of Conservation
Conservation Education Unit
Education Section

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Conservation education encompasses all the activities and experiences which result in learning about people's dependency upon and use of natural resources to satisfy their needs and wants. Since 1941, the Missouri Department of Conservation has supported a *formal education program* through Missouri's public and nonpublic schools. This formal education program is being expanded with the development of the *Conservation Education Series.* The series will include instructional units designed to aid teachers in their efforts to integrate conservation concepts into appropriate junior and senior high school curricular areas.

The development of the *Conservation Education Series* is a formidable challenge involving many individuals. We are indebted to Director Larry R. Gale and Assistant Director Allen Brohn for their support and encouragement. We are also indebted to Donald K. Heard, superintendent of education, and Al Palladino, assistant superintendent of conservation education, for their guidance and assistance.

This series would not be possible without the contributions of each instructional unit's author and artist. Thanks to Elaine Callaway, conservation education projects coordinator, and Rodney Green, conservation education consultant, for their editing and production efforts.

The *Conservation Education Series* is dedicated to the Department's conservation education consultants, past and present. This small group of men and women have recognized education as a vital and important force in resource conservation...and have accepted the challenge. The conservation challenge should concern all of us, but especially those charged with educating today's youth. We hope this series will aid Missouri teachers in meeting this challenge.

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How to Use this Instructional Unit

The *Biogeography of Missouri* Instructional Unit is designed t help social studies or science teachers incorporate ecological concepts into the teaching of science and Missouri geography.

The unit provides descriptions of each of the biogeographic regions and includes examples of plant and animal associations specific to Missouri. Objectives are listed for the unit in general and more specifically in each lesson plan. Also this unit addresses the following Basic Essential Skills Test (BEST) objectives:

Reading/Language Arts #5, 6, 12, 13, 15, 16, 17, 21
Mathematics # 7, 8, 10, 11

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Topic Outline

I. Introduction
- A. Importance of biogeography
- B. Objectives of the unit

II. Basic Biogeography
- A. Definition
- B. Biotic associations

III. Biotic Pyramid
- A. Abiotic factors
  1. Soils
  2. Landforms
  3. Climate
- B. Biotic factors
  1. Plants
  2. Animals
  3. Decomposers
  4. Man

IV. Biogeographical Regions
- A. Characteristics
  1. Landforms
  2. Climate
  3. Soils
  4. Vegetation
  5. Fauna
- B. Regions
  1. Glaciated prairie
  2. Unglaciated prairie
  3. Ozark
  4. Southeastern lowland

Introduction

The primary goal of this unit is to introduce junior and senior high school students to basic biogeography. The importance of biogeography as a science lies in the fact that all living organisms are restricted to a place on the earth's surface by the climate, soil and landform conditions. These abiotic factors control the growth and development of the biosphere. The ecologically sound maintenance of the biosphere is essential for human survival. The same abiotic factors of soil, climate and landform that control the natural biosphere apply when man domesticates plants and animals. An understanding of biogeographic principles and their application in agriculture will assure a continued food source for human populations.

Objectives

The general objectives of this instructional unit are:
Each student should be able to:

1. Define biogeography.
2. Name the four biogeographical regions of Missouri.
3. Draw the approximate boundaries of each biogeographical region on an outline map of Missouri.
4. Describe the landforms, climate and soils for each biogeographical region of Missouri.
5. Name representative mammals, birds, fishes and trees for each biogeographical region.

Refer to individual lesson plans for more specific objectives.

Basic Biogeography

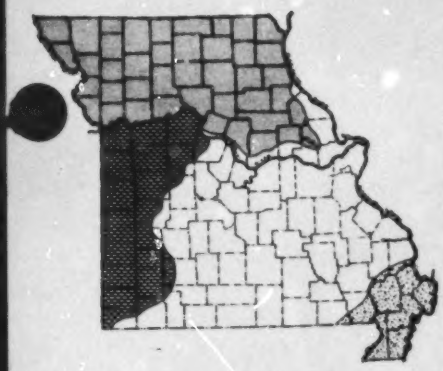
Biogeography is the branch of geography that deals with the areal or geographic distribution of plants and animals. The map is the tool the geographer uses to illustrate areal distribution.

Each region delineated on the map (figure 1) represents an association of plants and animals that occupy that region. This floral and faunal association indicates the adaptability of resident plants and animals to the physical variables of the region. Those physical variables are determined by the regional earth-sun relationship for that latitude and elevation.

The sun provides the energy to drive the atmospheric and hydrologic circulation systems. These circulation systems then establish the climate, which through geologic time, weathers the rock to form the soil layer. The soil layer, which occupies the surface of the landform, provides the physical support for all terrestrial plants of the biosphere.

Soil, landforms and climate determine plant associations in a particular region.

Thus, soil, landform and climate determine the association of plants that can survive in a particular location. The plant associations and water supply determine the habitat conditions of a region. Habitat conditions, including an array of additional physical variables, dictate the associated animal species, based on species evolutionary history.

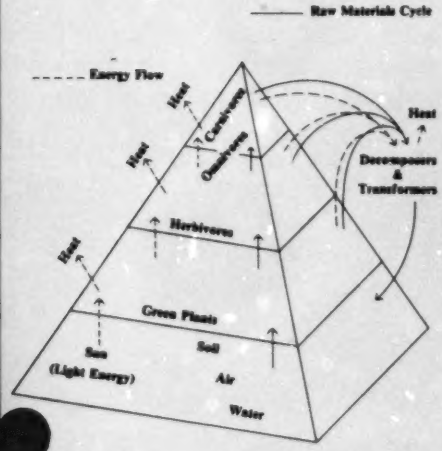


The map of Missouri's general biogeography (figure 1) delineates four biotic associations as defined by Steyermark (1963). The portion of the state north of the Missouri River was glaciated during the ice ages and has been designated the *Glaciated Prairie Region*. A second region of prairie occurs south of the Missouri River along Missouri's western border and has been named the *Unglaciated Prairie Region*. The largest biogeographical area of the state is the *Ozark Region*, which is a rugged, unglaciated forest area. The fourth biogeographical area is the *Southeastern Lowland Region*, commonly referred to as the Bootheel.

Missouri's four biogeographical regions are very generally defined with corresponding plant and animal associations that are products of a unique geologic and climatic history. The lines on the map that separate one region from the next are not meant to be sharp boundaries of demarcation. Rather these lines delineate zones of transition where one biogeographical association grades into the next, almost imperceptibly to the casual observer.

Many species of mammals, birds and fishes occupy the herbivore, omnivore and carnivore niches of the biotic pyramid in each biogeographic region. Missouri ecosystems contain complex food webs which involve many animal species. For the purpose of illustration, only a few characteristic species will be listed as representative of the fauna of each biogeographical region. Many migratory birds are residents of Missouri during part of the year. These creatures have a biogeography that doesn't adhere to state boundaries and therefore will not be discussed.

The Biotic Pyramid



The biotic pyramid illustrates a number of principles that govern the biosphere. As stated above, the abiotic conditions (physical variables of soil, landforms and climate) control the distribution of plant associations. The plant associations control the animal associations both in kind and size because they are the food and habitat of the animals. The decomposers return to the soil the unused nutrients from the biosphere that are needed to maintain the fertility and equilibrium of the system.

Only humans, among all the consumers at the top of the biotic pyramid, are in a position of control. This control must be exercised wisely because our food source depends upon careful maintenance of plant associations. Understanding the abiotic factors which control the biogeographical distributions of the biosphere is basic to survival.

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Biogeographical Regions

Missouri's climate is classified as humid continental in the north and humid subtropical in the south.

Each biogeographical region can be described by its dominant vegetation, a product of regional soils, climate and landforms. The *climate* of Missouri is classified as humid continental in the north and humid subtropical in the south. Average annual temperatures in Missouri range from 53°F in the northwest to 59°F in the southeast. (Refer to Appendix 5 for complete Fahrenheit-centigrade temperature conversions.)

The *soils* in Missouri are more variable than the climate. They belong to a general group of soils formed in cool-temperate to temperate, humid climates under forest vegetation. They are characterized by a highly leached topsoil horizon (for more information on soil horizons, refer to the Soil Conservation Service, U.S. Department of Agriculture teacher guide, *Conserving Soil*).

Due in part to their older geological formation age and heavier annual precipitation, Ozark topsoils are highly leached of soluble base minerals and nutrients. The more recently developed soils of the drier northwestern and western portions of Missouri exhibit mineral and nutrient leaching, but to a lesser extent.

The *landforms* of the state range from nearly flat in the floodplains of the Mississippi and Missouri rivers to rugged and mountainous in the Ozarks.

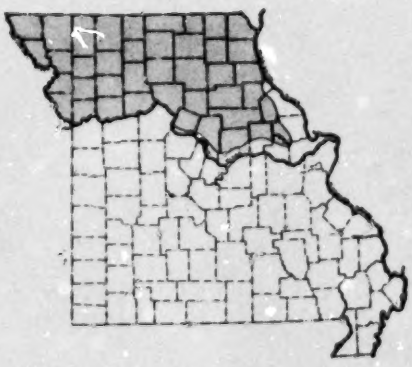
The next four sections of this unit will give a brief description of the characteristic landforms, climate and soils of each biogeographical region in Missouri. Each region's dominant vegetation will be listed along with some of the characteristic fauna.

GLACIATED PRAIRIE REGION

The *Glaciated Prairie Region* has been named the Oak-Hickory-Bluestem Parkland (Bailey, 1978). The region has many deciduous trees which grow along the water courses that flow through the prairie.

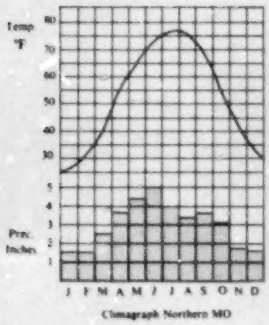
Landforms

Northern Missouri, north of the Missouri River, was glaciated. The glacial deposits (till) laid down by the ice were later covered by loess. Loess is a wind-blown silt deposited during the drier periods between glacial episodes. The till and loess have been deeply eroded by running water.



The topography is mostly gently rolling plains but many high rounded hills break the monotony. Steep bluffs occur along some of the valleys. Elevations range from 400 feet along the Mississippi River to over 1,200 feet along the Missouri-Iowa border.

Climate



Climagraph Northern MO

The Glaciated Prairie is the driest region in the state with an annual average precipitation of 37 inches. More than 60 percent of the precipitation falls in the months of May through September. Summers are usually hot with July average temperatures near 77 °F. Winters are short and relatively mild with a January average of 27 °F. Average annual temperature is 53 °F. The average date of the first killing frost in the northeast part of the state is October 11, leaving a frost-free season of almost 174 days.

Soils

The soils of the Glaciated Prairie Region are predominately Mollisols and Alfisols. These soils are dark and fertile, developing in loess over glacial till. Mollisols are darker and more fertile than Alfisols because they developed under grass vegetation. This region also has Entisols on the steep slopes, where erosion has reduced soil development. Entisols also occur in the valley alluvium, where water has recently deposited sediments and the length of time for soil formation has been limited. The eastern part of the region has a deep claypan soil that is poorly drained because of its impermeability.

Vegetation

Even though a biogeographical region has been altered by the activities of modern man, it continues to be defined by its natural vegetation. Clues to the composition of the natural vegetation of the Glaciated Prairie Region have been gleaned from observation of undisturbed areas and information on presettlement vegetation, researched and mapped by Schroeder (1981).

The native vegetation of the Glaciated Prairie Region is separated into three dominant plant associations. The upland portion of the region was dominated by native grasses such as big and little bluestem, Indian grass, switchgrass and side-oats grama (Toney, in Allgood and Persinger, 1979).

The eroded, shallow soils of the steep side slopes restrict some types of vegetation. Thus, the more tolerant hardwood trees such as oaks (white, black, shingle and northern red) and hickories (shagbark and bitternut) are the dominant plants on the valley sides. The valley bottomlands along the coves and streams are also covered by timber of the elm-ash-cottonwood association mixed with walnut, pecan and bur oak. The dominants are white ash, American and slippery elm and eastern cottonwood.

Changed by man, the typical landscape of the Glaciated Prairie Region today contains broad cultivated fields on the ridgetops and in the wide valleys. Soybeans, corn, milo and hay are the main crops of the uplands. The valley sides are open pastures alternating irregularly with woodlots and timbered pastures.

big bluestem

Fauna

Before man's intervention, the Glaciated Prairie had a large amount of woodland-prairie edge. This "edge" or ecotone is the interface between two distinctly different habitat types. Many of Missouri's common species that prefer edge habitats are found in northern Missouri today. Red fox and coyote are common to this region, with badger and Franklin's ground squirrel more numerous

here than in other parts of the state.

Some bird species which nest in this region include the bobolink and song sparrow, as well as meadowlark, dickcissel and prairie horned lark. An important game bird species restricted to northern Missouri is the ring-necked pheasant. This native of China appears to prefer the recently deglaciated regions of the Missouri-Iowa border. The pheasant's adaptability to extreme northern Missouri supports the supposition that this region and areas of China are biogeographically similar.

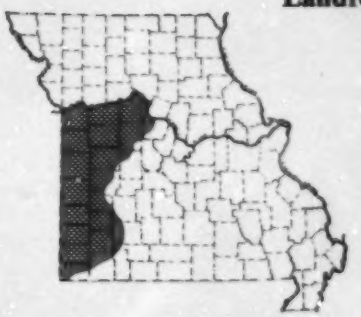
bullhead catfish

Northern Missouri streams characteristically exhibit low gradient and high turbidity, thus limiting fish species to those tolerant of such conditions. Three small fish species that prefer the waters of northern Missouri are the red shiner, bigmouth shiner and plains minnow. Catfishes, carp and river carpsucker are representative of larger species (Pflieger, 1975).

UNGLACIATED PRAIRIE REGION

The *Unglaciated Prairie Region* has an irregular boundary with the Ozark region to the east created by the fingerings of the woodlands that follow the water courses. Vegetation differs from one geological formation to the next because the loess in this region is thinner and the soils are more characteristic of local rock parent material.

Landforms

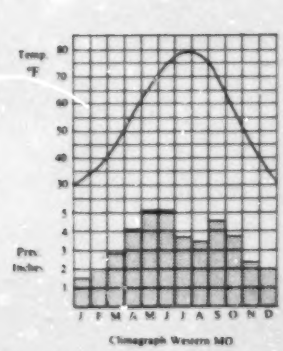


The uplands of the Unglaciated Prairie Region are level to gently rolling and alternate with the broken, rocky ground on the hill slopes and in the valleys. The landforms are a product of the sculpturing of the underlying sandstones, shales and chert-laden limestones of the Mississippian and Pennsylvanian geologic time periods.

Broad, shallow, wet valleys occur where impermeable shales are the underlying rock unit. These valleys contain wet meadow and bottomland prairie flora. Resistant sandstone ridges and bluffs create upland prairie chert glades that are floristically unique (Steyermark, 1963).

Climate

Average annual temperature for the Unglaciated Prairie Region is 56°F. January average temperatures range from 30°F in the north to 36°F in the south. July average temperatures are in the high 70s throughout the region. Precipitation decreases to the north with Neosho averaging nearly 43 inches per year compared with 37 inches per year at Kansas City. Precipitation is concentrated in the spring and summer months with maximums of more than five inches occurring in both May and June. The southwest corner of the state averages about 180 frost-free days per year.



Climograph Western MO

Soils

The soils of the Unglaciated Prairie Region are similar to those of the Glaciated Prairie, mostly Mollisols and Alfisols. Some of these soils have a loess parent material but most are weathered from sedimentary rocks. Some of the dark fertile soils of this region are poorly drained. A thick impermeable clay layer in the subsoil retards drainage, particularly in the soils that weathered from shale.

Some of the soils of the region are shallow. Rock outcrops are common on the side slopes and valley floors of large streams. The upland soils developed beneath tall grass prairie vegetation whereas the valley soils were formed beneath a hardwood forest (Allgood and Persinger, 1979).

Vegetation

June grass

The plant associations of the upland Unglaciated Prairie have many of the same dominant species as the Glaciated Prairie; big and little bluestem, Indian grass and switchgrass are common to both regions. In addition, the Unglaciated Prairie has prairie dropseed, June grass, purple top, slough grass and Canada and Virginia wild rye as dominants (Toney, in Allgood and Persinger, 1979).

The Unglaciated Prairie has several large areas of native grasses which remain in a nearly natural state since they were used for grazing and hay production. Even so, the vast majority of the region's natural prairie vegetation has been converted to fescue. The Missouri Prairie Foundation, The Nature Conservancy and Missouri Department of Conservation have purchased many areas of native grasses for preservation and study.

The side slopes and valleys of the region contain the same oak-hickory and elm-ash-cottonwood associations found in comparable northern prairie areas. The dominant hickories are the shellbark, mockernut and black. Walnut and pecan are major nut-producing species.

Fauna

greater prairie chicken

Due to similarities in habitat, Glaciated Prairie species such as coyote and red fox are also found in this region. The black-tailed jackrabbit, now rare in Missouri, is also found here. This herbivore is a resident of the open plains and the Missouri southern prairies are the eastern extent of its geographic range in the United States. It has adapted to agriculture with limited success and only a few can be found in the extensive pastures and hay fields of the Missouri southern prairie.

The greater prairie chicken is a characteristic avian species of the Unglaciated Prairie. Its numbers are increasing because of improved management practices and preservation of more native prairie areas. The upland sandpiper is found in both glaciated and unglaciated prairies, and marsh hawk populations are more abundant in the latter region than in other areas of Missouri. The scissor-tailed flycatcher is found only in the Unglaciated Prairie, this being the northeastern limits of its range.

Unglaciated Prairie streams are less turbid than glaciated ones, but the fish species found are basically the same. Catfishes are one of the more important groups of large fishes in prairie streams.

Fathead minnows and orangespotted sunfish are also representative species (Pflieger, 1975).

OZARK REGION

Of the four biogeographical regions in Missouri, the Ozark is the most diverse. It has the greatest relief, the largest area, the most diverse geology, the greatest climatic variability and is the least altered of Missouri's biogeographic regions. Many areas of timber have been harvested but have renewed themselves to their natural vegetative association.

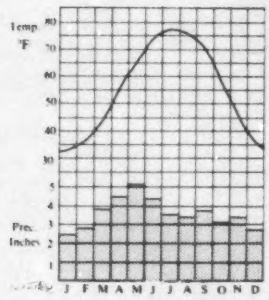
Landforms

The major part of the Ozark Region is an uplifted sedimentary plateau that circumscribes the igneous dome called the St. Francois Mountains. Outcrops of many different igneous and sedimentary rocks occur throughout the region. Large areas of surface and near surface rocks create treeless areas called glades. Many steepsided valleys and bluffs provide unique landform habitats for a very diverse biogeography.

The highest point in Missouri occurs in this region. Taum Sauk Mountain in Iron County is 1,772 feet above sea level. The lowest elevation of the region, about 350 feet, occurs along the Ozark-Bootheel boundary. Most of the land area of the Ozark Region is in hill slopes and local relief is as much as 700 feet.

Climate

The Ozark Region has a climate characterized by an average annual temperature of 56 °F. July is the warmest month with a 78 °F average temperature and January the coldest with a 33 °F average. The summer temperature varies from a daytime July average in the nineties to a July evening average in the sixties. The winter average lows are in the twenties and the average highs in the forties.



Climagraph Ozarks MO

It is not uncommon for temperatures to exceed 100 °F in the summer and temperatures below zero are not uncommon in the winter. Precipitation in the Ozarks averages about 42 inches per year with more than 14 inches of this total occurring in April, May and June. January is the driest month averaging about 2 inches of precipitation per year.

Soils

The soils of this region, like the landforms, display the greatest diversity in the state and are mostly Alfisols and Ultisols (Allgood and Persinger, 1979). The parent materials from which the soils were formed range from very old granites and Paleozoic limestones and sandstone to Pleistocene loess and alluvium. The soils that were weathered from the high magnesium limestones are alkaline, whereas those weathered from most of the other rock parent materials are acidic (Steyermark, 1963). Many soils also weathered from a cherty limestone.

The origin of soils from varied parent materials has created two problems. First, the soils are very rocky, containing large amounts

of chert. Second, the limestone parent material forms clays that accumulate in the subsoil to form a fragipan. This fragipan layer retards root penetration and therefore stunts tree growth.

Flora

flowering dogwood

The flora of the Ozark Region is classified as an oak-hickory forest association even though the region has the most diversified flora of any part of the state (Steyermark, 1963). The limestone glades, moist bluffs and ravines, sinkholes, sandstone ridges and granite glades each have their own unique flora.

The dominant oaks and hickories merge in many areas with a pine-oak association. The indigenous pine is the shortleaf pine. The dominant oaks are the white, black, post, scarlet and blackjack. The understory trees that add so much beauty to the Ozark woods in the spring are the redbud, downy serviceberry and flowering dogwood. The green spots in the winter Ozark woods are provided by the abundant eastern red cedar with shortleaf pine in some areas.

Fauna

white-tailed deer

Most of the common mammals living in the Ozark Region are forest dwellers. Gray fox and bobcat are more abundant here than in other portions of the state, and the chipmunk is a common resident. The region also has large areas of habitat suitable for many of the forest edge and prairie mammals found in adjoining regions of the state.

Though found statewide, the white-tailed deer is a representative mammal because of its preference for the habitat provided by the oak-hickory forest association. The abundant acorn crop provides a staple winter food source for this herbivore.

The population of deer found in the remainder of the state were transported to those regions from the Ozarks by Conservation Department personnel. Man is the major deer predator today, replacing large predators such as the mountain lion and timber wolf which historically controlled deer numbers.

The large trees along Ozark waterways provide habitat suitable for the pileated woodpecker. The ovenbird and the summer tanager are common nesting birds, and the chuck-will's widow, a relative of the whip-poor-will, is seldom found in Missouri outside the Ozarks.

The wild turkey is the game bird species selected to represent the Ozarks. The turkey was almost extirpated from the region by market hunting and habitat destruction. Trapping and restocking of this majestic bird by the Conservation Department has restored large flocks in every county of the Ozark Region. The turkey requires a good acorn crop as a primary winter food source and the dominant oaks provide this sustenance.

Ozark streams typically consist of a series of short pools and well-defined riffles. Abundant springs provide a reliable source of water for the streams. The dominant large fishes are the suckers and sunfishes. The longear sunfish is one of the most abundant and generally distributed Ozark stream fishes. The bleeding shiner, northern studfish and rainbow darter represent smaller Ozark species (Pflieger, 1975).

SOUTHEASTERN LOWLAND REGION

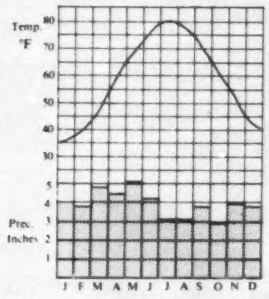
The *Southeastern Lowland Region* is a unique section of Missouri. The region's physical environment is very different from the bordering Ozark Region. Its biogeographical uniqueness is exemplified by its lower landform elevations, warmer and wetter climate, and alluvial soils.

Landforms

The Southeastern Lowland Region is a broad floodplain of the Mississippi River and its tributaries. Many low terraces exist, but Crowley's Ridge provides the only observable variation in the nearly level topography. The general elevation of the area is from 250 to 350 feet above the mean sea level. The drainage of the area has been altered by extensive channelization and tile drainage projects for expansion of agricultural land.

Climate

The Bootheel climatic region of the state had an average temperature of approximately 59 °F for the years 1941-70. The yearly precipitation for this same period averaged just over 46 inches. The wettest year was 1957 when almost 77 inches of precipitation were recorded. Forty percent of the precipitation falls from March through June. This region is the wettest and warmest part of the state and supports many species that cannot tolerate colder portions of Missouri.



Climagraph S.E. Lowlands

Soils

The alluvial soils of the Southeastern Lowland are the product of accumulated sediment from the frequent flooding of the Mississippi River and its tributaries. This flooding not only provided sediment, but also a wetland type of vegetation, rich in organic material for the soil layer. The sediment layers retarded soil development and produced Entisols while the organic layers enhanced soil development and produced Mollisols. The dominant soil order is Alfisol which is characteristically associated with forest vegetation. Most of the soils of the landscape are under cultivation with cotton, corn, soybeans and rice, the dominant planted crops.

bald cypress

Vegetation

The natural vegetation of the Southeastern Lowland Region before agriculture could have been best described as luxuriant deciduous forest. The dominant species are the silver and red maples, green ash, hackberry and swamp cottonwood.

The region is also the northern extent of the Gulf Coast species of bald cypress, sweetgum and water tupelo. These three tree species, along with the pumpkin ash, northern catalpa, yellow poplar, willow oak and swamp chestnut oak, occur naturally only in this region of Missouri.

A long narrow strip of land known as Crowley's Ridge separates the Bootheel from the main body of the Ozark forests. American holly, typically a tree of the southeastern United States, grows naturally on the sandy soils of Crowley's Ridge (Settergren

and McDermott, 1974). American beech, a species which has commercial distribution in the northeastern states, is found only in the Bootheel Region of Missouri.

Most of the region's natural vegetation has been cleared for agriculture. The diverse and unique vegetation, once abundant, is now limited to swampy low areas or steep ridges not suitable for the plow. Big Oak Tree State Park in Mississippi County contains a remnant of the virgin forest that is representative of the natural vegetation of this region.

Fauna

The typical fauna of the Southeastern Lowland must be able to withstand wet habitats. Beaver, a characteristic mammal, is abundant in this area. The swamp rabbit, though rare, is found exclusively in this region. It lives in wet lowlands and along banks of streams and drainage ditches.

beaver

Black vultures and the fish crows, distinct from statewide turkey vultures and common crows, occupy this region as the northern extent of their southeastern U.S. ranges. Occasionally fish crows are sighted around Table Rock Lake and along the Mississippi River as far north as St. Louis. Though found statewide, the mourning dove's abundance here provides many successful hunting trips. The Bootheel is also the Missouri stronghold of the endangered red-shouldered hawk.

Approximately 1,200 miles of ditches, constructed to drain the swamps, are the principle habitat for fishes. The bowfin, also called the grinnel or cypress trout, is a characteristic bootheel fish. Small fish species are represented by the blacktail shiner, pirate perch and dusky darter.

Lesson Plan No. 1

TITLE: Basic Biogeography of Missouri

MATERIALS: Transparencies of Biotic Pyramid (Appendix 1) and Biogeographical Regions of Missouri (Appendix 2); large relief map of Missouri; overhead projector; film: *A Way of Life* (MDC Film Loan); 16mm projector and screen.

OBJECTIVES: After completing the lesson, the student should be able to:

1. Define biogeography.
2. Determine what factors enable plants to survive in any biogeographical region.
3. Identify the four biogeographical regions of Missouri and draw their approximate boundaries on a Missouri map.
4. Explain the structure of the biotic pyramid.
5. Analyze man's interaction with the biotic pyramid and his responsibility for maintaining the biosphere.

METHOD: Film, lecture, discussion

PROCEDURE:

I. Introduction
   Why are animals found in a particular habitat?

II. Presentation
   A. Definition of biogeography—the branch of geography that deals with the distribution of organisms or the branch of biology dealing with geographic distribution of plants and animals.
   B. Ecological factors that determine survival
      1. Of plants
         a. sun
         b. soil
         c. climate
         d. landforms
      2. Of animals
         a. plant associations
         b. water
         c. other physical conditions
   C. Four biogeographical regions of Missouri
      1. Glaciated Prairie, Unglaciated Prairie, Ozark, Southeastern Lowland
      2. Type of boundary between regions—zones of transition
   D. Film: *A Way of Life*
   E. Biotic Pyramid
      1. How it functions
      2. Explanation of structure-soil, landforms and climate control where plants and animals will live and die. Decomposed materials (animal refuse, waste, etc.) return nutrients to soil to maintain fertility. We should maintain plant associations.
      3. Responsibility of people—must exercise control wisely as their survival depends on the maintenance of the biosphere.

III. Summary—Format for study
   A. Identification and location of regions

B. Regional characteristics
   1. Soil
   2. Landforms
   3. Climate
   4. Plants
   5. Animals

Lesson Plan No. 2

TITLE: The Glaciated Prairie Region

MATERIALS: Transparencies of Biogeographical Regions of Missouri (Appendix 2); Precipitation Zones (Appendix 3) and Climagraphs (Appendix 4); overhead projector; film: *A Prairie Should Be Forever* (MDC Film Loan); 16mm projector and screen.

OBJECTIVES: After completing the lesson, the student should be able to:
1. Define till and loess.
2. Discuss type of topography, amount of rainfall and temperatures of this region.
3. Name the characteristics of Mollisols and Alfisols.
4. Identify grasses and hardwood trees found in this region.
5. List important agricultural crops produced in this area.
6. Name a game species, bird species and several fish species found in this region.

METHOD: Lecture, discussion, film

PROCEDURE:

I. Introduction
   A. Point out Glaciated Prairie Region on the transparency
   B. Identify southern boundary of last glacial episode

II. Presentation
   A. Definitions
      1. Till: sediment of random size deposited by glacial ice
      2. Loess: wind blown silt deposited between glacial episodes
   B. Gently rolling topography of this region
   C. Precipitation and temperature
      1. Average 37 inches; driest region in state
      2. Average annual temperature 53 °F
      3. Climagraph
   D. Common soil structures
      1. Mollisols—soil with dark surface layer developed under grass vegetation
      2. Alfisols—soil with light-colored surface horizon with forest vegetation
   E. Grasses—big and little bluestem, Indian grass, switchgrass, side oats grama
   F. Hardwood trees—oaks, hickories, elm, ash, cottonwood, walnut, pecan
   G. Agricultural crops—soybeans, corn, grain sorghum, hay
   H. Common mammals, birds and fish
      1. Mammal—coyote, red fox, badger, Franklin's ground squirrel
      2. Bird—bobolink, song sparrow, meadowlark, ring-necked pheasant,

dickcissei, prairie horned lark
3. Fish—red shiner, bigmouth shiner, plains minnow, catfish, river carpsucker

I. Film: *A Prairie Should Be Forever*

III. Summary
A. Compare native prairie ecosystem as depicted in the film to current agricultural systems in the glaciated prairie region.
B. Next lesson will focus on Unglaciated Prairie

Lesson Plan No. 3

TITLE: The Unglaciated Prairie Region

MATERIALS: Transparencies of Biogeographical Regions of Missouri (Appendix 2) and Climagraphs (Appendix 4); overhead projector; film: *Farming With Nature* (acquire through MDC personnel); 16mm projector and screen.

OBJECTIVES: After completing the lesson, the student should be able to:
1. Compare soil types from glaciated and unglaciated prairie regions.
2. Identify some landform characteristics of this region.
3. Know amount of precipitation for and temperature range of this region.
4. List types of soils in this region.
5. List grasses and trees native to this region.
6. Recognize mammal, bird and fish species that reside in this region.

METHOD: Lecture, discussion, film

PROCEDURE:

I. Introduction
A. Point out Unglaciated Prairie Region on transparency
B. Mention that the last glacier didn't reach this region

II. Presentation
A. Soil
1. Loess is thinner here than in the glaciated prairie region. The soil retains characteristics of rock parent material.
2. Mollisols and Alfisols are common to this area.
B. Landform characteristics
1. Uplands level to gently rolling with some broken, rocky ground
2. Contains shale, sandstone, limestone
3. Has broad, shallow, wet valleys
C. Precipitation and temperature
1. Greatest precipitation during spring and summer (May and June)
2. August annual temperature 56°F
3. Climagraph
D. Grasses and trees
1. Grasses—prairie dropseed, June grass, purple-top, slough grass, Canada and Virginia wild rye, bluestems, Indian grass and switch-grass
2. Trees—shellbark, mockernut, and black hickories; oak-hickory and elm-ash-cottonwood associations; walnut, pecan
E. Mammal, bird and fish species
1. Mammal—coyote, red fox, black-tailed jackrabbit
2. Bird—greater prairie chicken, upland sandpiper, marsh hawk, scissor-tailed flycatcher

3. Fish—catfish, flathead, minnows, orangespotted sunfish

F. Film: *Farming With Nature*

III. Summary: Compare characteristics of glaciated and unglaciated prairie regions.

Lesson Plan No. 4

TITLE: Ozark Region

MATERIALS: Transparencies of Biogeographical Region (Appendix 2) and Climagraphs (Appendix 4); overhead projector; film: *More Than Trees* (MDC Film Loan); 16mm projector and screen.

OBJECTIVES: After completing the lesson, the student should be able to:

1. Recognize the diversity of this region.
2. Name the highest point in Missouri and its elevation.
3. Identify the temperature range and amount of precipitation for the region.
4. Identify the soils of this area and two problems associated with it.
5. Name the types of trees found in this region.
6. Name four mammals found in this region.
7. List the major fish native to the Ozark Region.

METHOD: Lecture, discussion, film

PROCEDURE:

I. Introduction
   A. Locate Ozark Biogeographical Region on transparency
   B. Identify it as Missouri's most visited tourist area
      1. Natural scenic areas
      2. Man-made lakes

II. Presentation
   A. Exceptional diversity
      1. Greatest relief, largest area, most diverse geology
      2. Greatest climatic variability, least altered
   B. Highest point in Missouri and its elevation
      1. Taum Sauk Mountain in Iron County
      2. 1,772 feet above sea level
   C. Precipitation and temperature
      1. 42 inches precipitation per year; January driest month
      2. Excess of 100°F in summer and below zero in winter
      3. Climagraph
   D. Soil
      1. Most diverse soil
      2. Mostly Alfisols and Ultisols
      3. Weathered from different parent materials
         a. soils are very rocky with large amount of chert
         b. limestone parent material forms clay which retards root growth and stunts plants
   E. Abundant trees
      1. Coniferous—pine trees
      2. Deciduous—oak-hickory association
   F. Mammal, bird and fish species
      1. Mammal—gray fox, bobcat, chipmunk, white-tailed deer

2. Bird—pileated woodpecker, summer tanager, ovenbird, chuck-will's widow, turkey
3. Fish—suckers, sunfishes, bleeding shiner, northern studfish, rainbow darter

G. Film: *More Than Trees*

III. Summary: Assign students to work individually or in small groups to design a brochure or write a commercial enticing vacationers to visit the state of Missouri, including any or all of its biogeographical areas. (The next lesson will conclude the discussion on biogeographical regions.)

Lesson Plan No. 5

TITLE: Southeastern Lowland Region

MATERIALS: Transparencies of Biogeographical Regions of Missouri (Appendix 2) and Climagraphs (Appendix 4); overhead projector and screen.

OBJECTIVES: After completing the lesson, the student should be able to:
1. State how this region is unique from the other three regions.
2. Compare average precipitation and temperature of this region with the other regions.
3. Name the major crops of this region.
4. List eight forest species that are common *only* to this area.
5. Name a fish, mammal and bird representative of the fauna of this region.
6. Develop a climagraph for the state of Missouri from the analysis of the climagraphs for the various regions.

METHOD: Lecture, discussion

PROCEDURE:

I. Introduction
- A. Locate Southeastern Lowland Region on transparency
- B. Point out how the Bootheel Region is unlike the other three regions
  1. Mississippi floodplain
  2. Crowley's Ridge

II. Presentation
- A. Unique characteristics of Southeastern Lowland
  1. Landform elevations are lower
  2. Climate is wetter and warmer
  3. Soils are alluvial
- B. Average precipitation and temperature
  1. Average annual precipitation—46 inches; wettest region in state.
  2. Average temperature—59 °F
  3. Climagraph
- C. Major crops
  1. Cotton
  2. Corn
  3. Soybeans
  4. Rice
- D. Forest species
  1. Bald cypress, sweetgum, water tupelo, pumpkin ash, northern catalpa, yellow poplar, willow oak, swamp chestnut oak
  2. American Holly, a tree found in the southeastern United States, can

be found on Crowley's Ridge, a long, narrow strip of land separating the Bootheel from the Ozark forest

E. Mammal, fish and bird species
   1. Mammals residing along streams and drainage ditches—beaver and swamp rabbit
   2. Representative birds of Bootheel—mourning dove, black vulture, fish crow, endangered red-shouldered hawk
   3. Fish species whose habitat is drainage ditches—bowfin, blacktail shiner, pirate perch, dusky darter

III. Summary
   A. Have students summarize the climagraphs for the various regions into a single climagraph for the state.
   B. Develop a chart depicting characteristic soils, climate, landforms, flora and fauna of the biogeographic regions of Missouri.

Glossary

Alfisol: soils developed with relative high base saturation, light-colored surface horizons, clay accumulations in the subsoil and are largely associated with forest vegetation.

alluvial: pertaining to material that is transported and deposited by running water.

association: a climax plant community identified by the combination of dominant species present.

biogeography: the branch of geography that deals with the areal distribution of the organisms of the biosphere.

biosphere: portion of the earth and its atmosphere that can support life.

carnivore: an organism, plant or animal, that feeds on animals.

carrion: the decaying and decomposing body of a dead animal, especially when regarded as food for scavengers (an animal that eats the dead bodies of animals not killed by itself).

climate: the sum total of all atmospheric or meteorological influences (mostly temperature, moisture, wind, pressure and evaporation) which combine to characterize a region and give it individuality by influencing the nature of its landforms, soils, vegetation and land use.

decomposer: an organism, usually a bacterium or fungus, that breaks down the bodies or parts of dead plants and animals into simpler compounds.

ecosystem: the interacting system of a biological community and its non-living environment.

ecotone (edge effect): a region of transition between two or more diverse ecosystems such as between a forest and a grassland.

Entisol: soils with limited development; these soils are commonly found on steep slopes or in recent water-deposited sediments.

extirpated: formerly occurring in Missouri, but not known to exist within the state at this time.

fragipan: dense, compact clay layer in the subsoil that is very slowly permeable to water. Usually has an abrupt upper boundary and is hard or very hard when dry and plastic and sticky when wet. It may be found in profiles of either cultivated or virgin soils, but not in calcareous material.

herbivore: an animal that feeds on plants.

igneous rock: rock formed by solidification from a molten or partially molten state.

landform: a discernible natural landscape that exists as a result of geological activity, such as a plateau, plain, basin, mountain, or the like.

loess: wind-blown and deposited silt.

Mississippian: of the fifth period of the Paleozoic Era between 345,000,000 and 310,000,000 years ago in North America. First principle coal producing period of Paleozoic Era.

Mollisol: soils with organic-rich dark surface layers developed under grass vegetation. The base saturation is above 50 percent.

omnivore: an organism that eats both animals and plants.

Paleozoic: of the geologic era covering the period between 600,000,000 and 230,000,000 years ago and was characterized by the development of the first fishes, amphibians, reptiles and land plants.

Pennsylvanian: of the sixth period of the Paleozoic Era in North America between 310,000,000 and 280,000,000 years ago. Preceded Mississippian Period.

physiography: The physical geographic description of the features of the earth.

Pleistocene: of the epoch covering the period between 600,000 and 12,000 years ago and was characterized by the spreading and recession of continental ice sheets and by the appearance of modern man.

sedimentary rock: rock formed and hardened of mechanical, chemical, or organic sediments by heat, pressure, or cementing substances such as humus and mineral oxides.

soil horizon: a layer of soil that is nearly parallel to the land surface and is different from layers above and below.

temperate: of climate, neither very hot nor very cold; temperate zone, either of two zones of the earth between the tropics and the polar circles.

till: sediment of random size deposited by glacial ice.

topography: is the hilliness, flatness, or amount of slope of the land. The relative positions and elevations of the natural or man-made features of an area that describe the configuration of its surface.

Ultisol: soils highly weathered with a very low base saturation.

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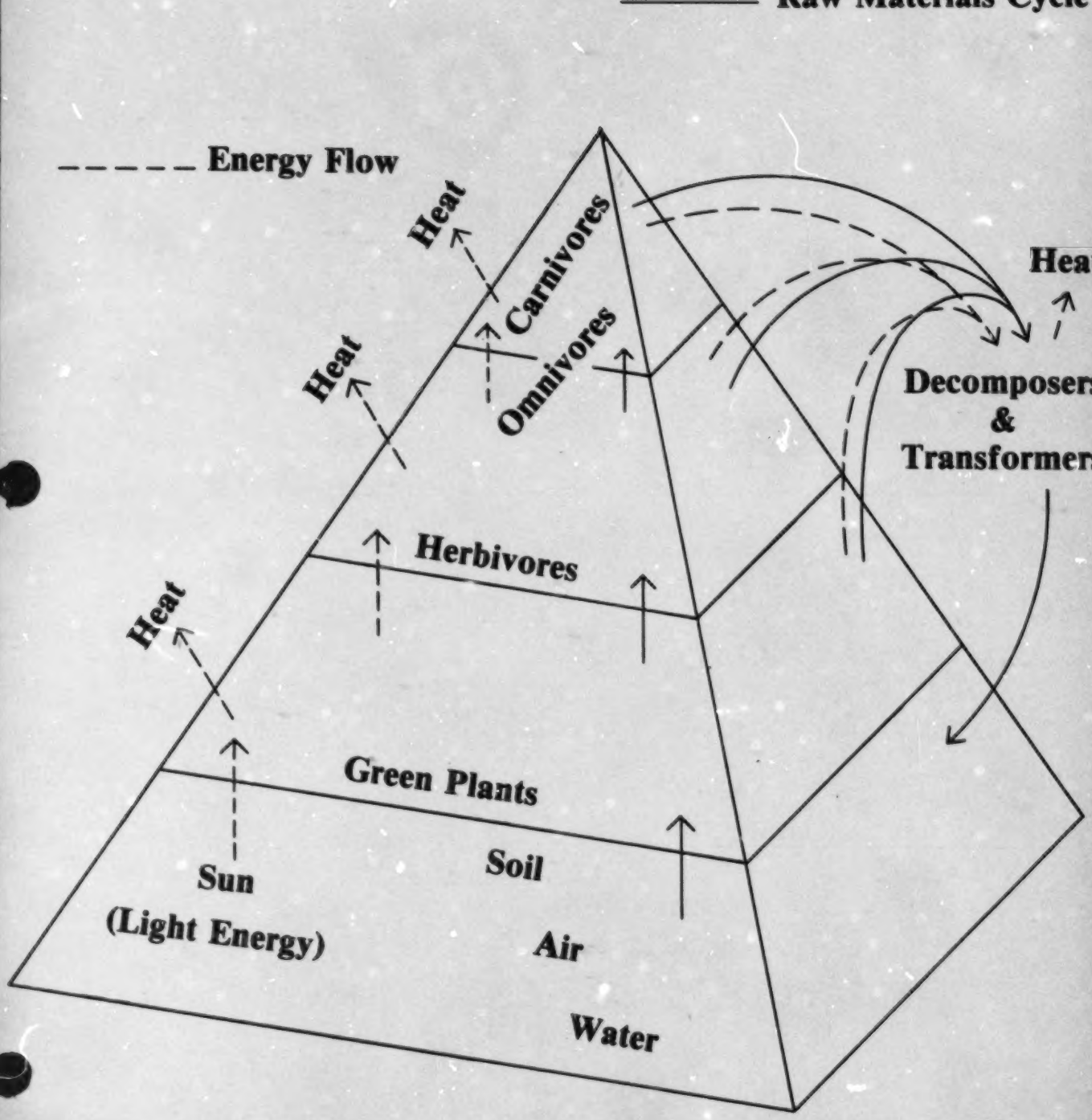
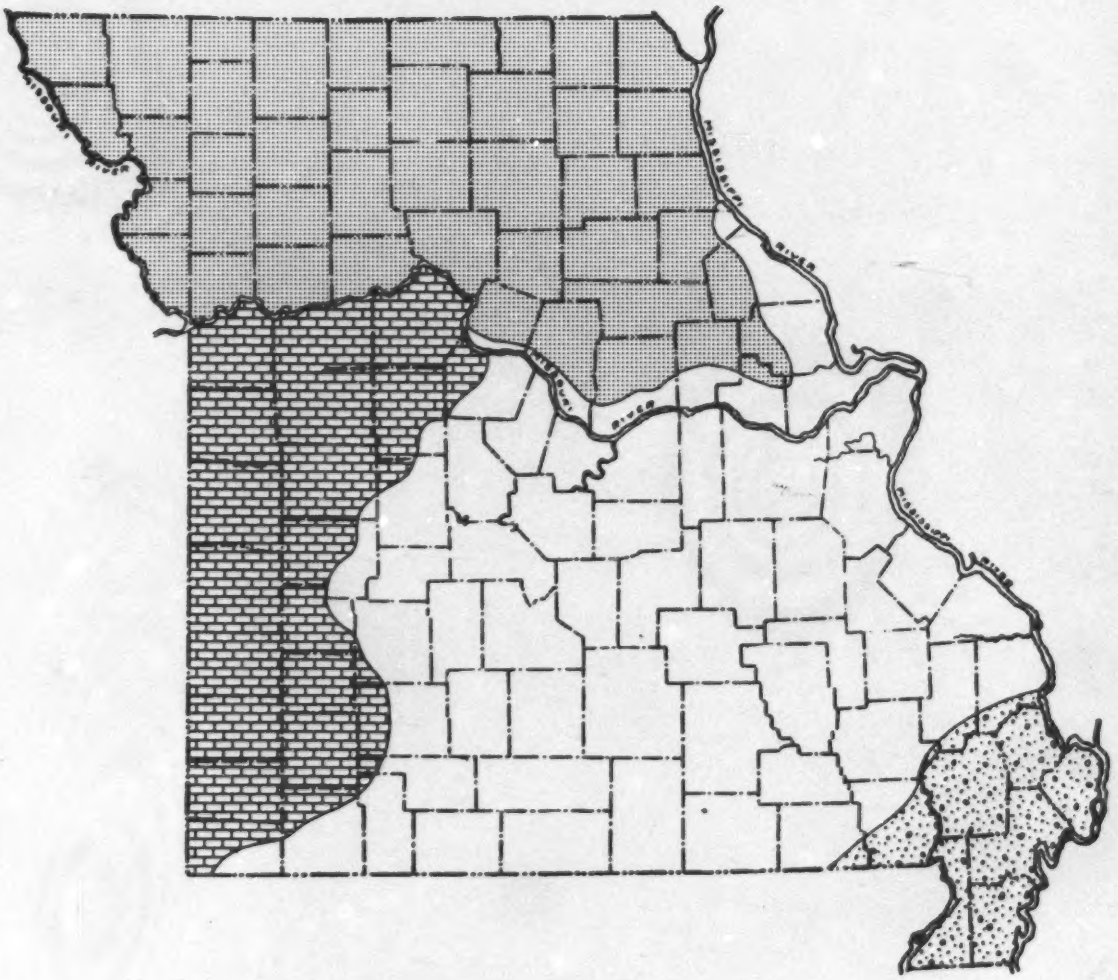
The Biotic Pyramid



Biogeographic Regions of Missouri



Prairie Region (unglaciated)

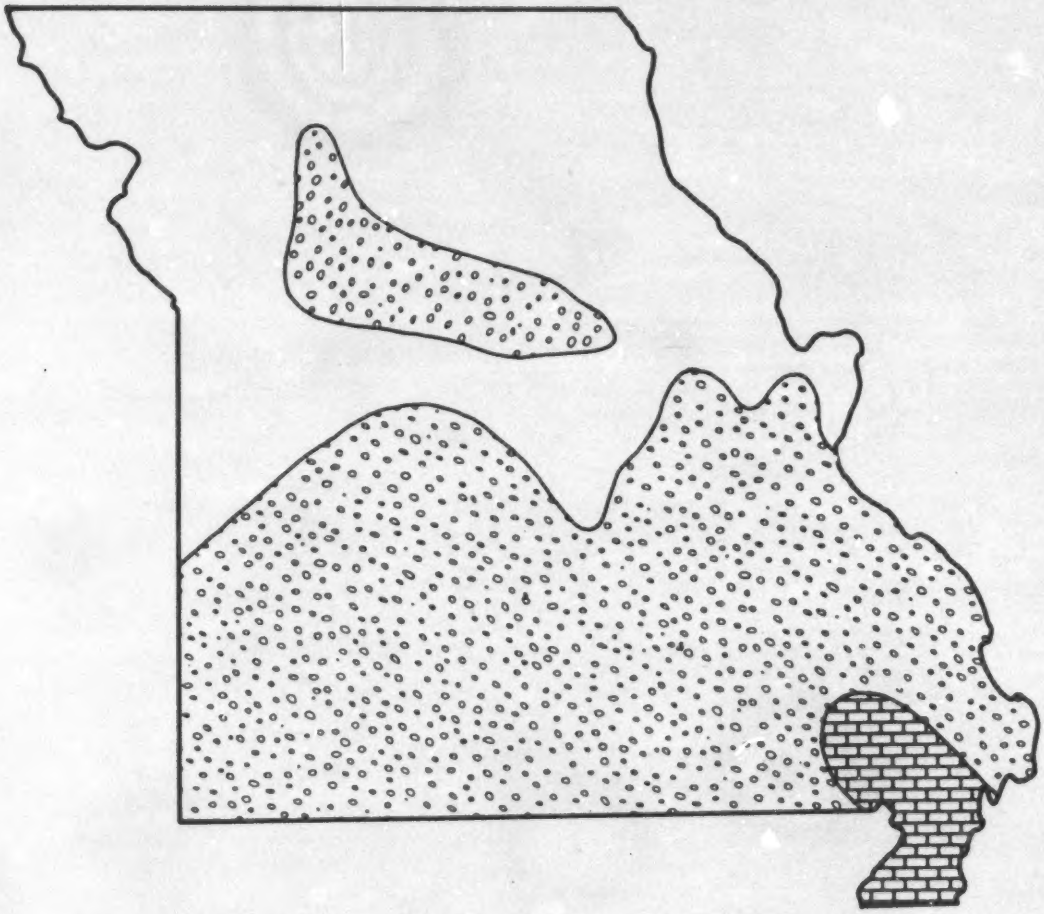
Prairie Region (glaciated)

Ozark Region

Southeastern Lowlands

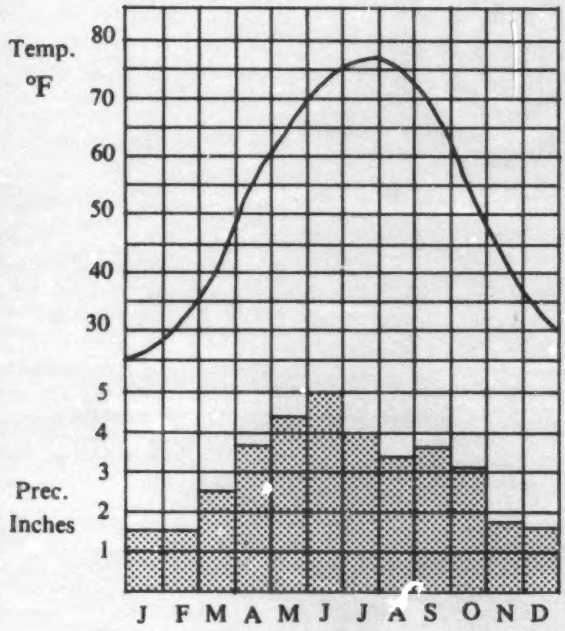
Precipitation Zones

Average Annual Precipitation

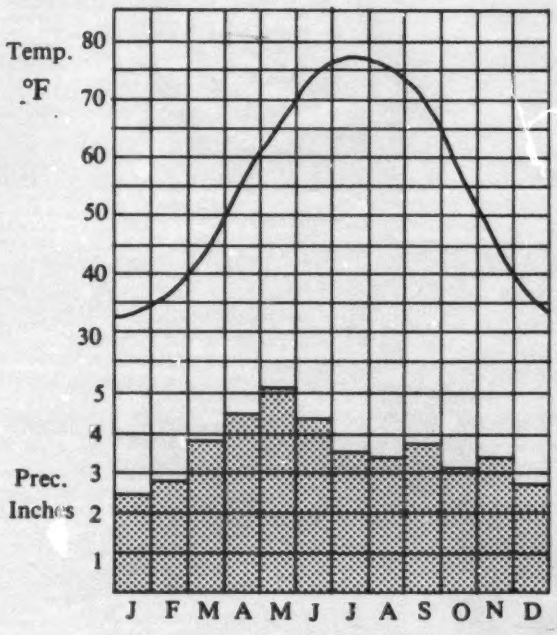


Centimeters	75-99	100-124	125-149
Inches	30-39	40-49	50-59

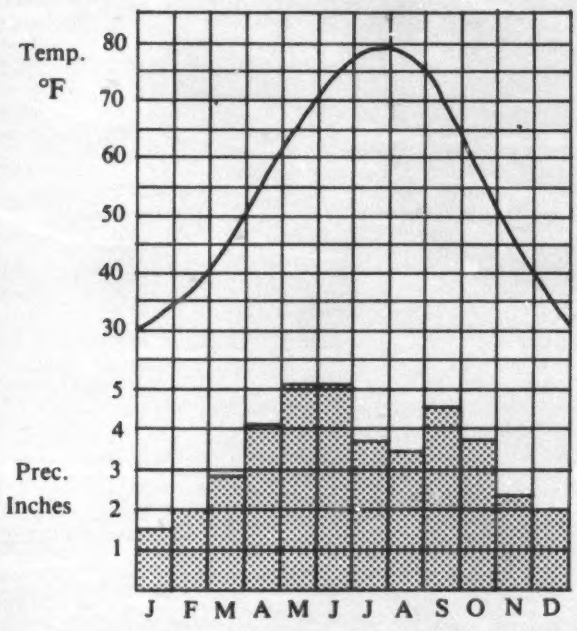
Climagraphs



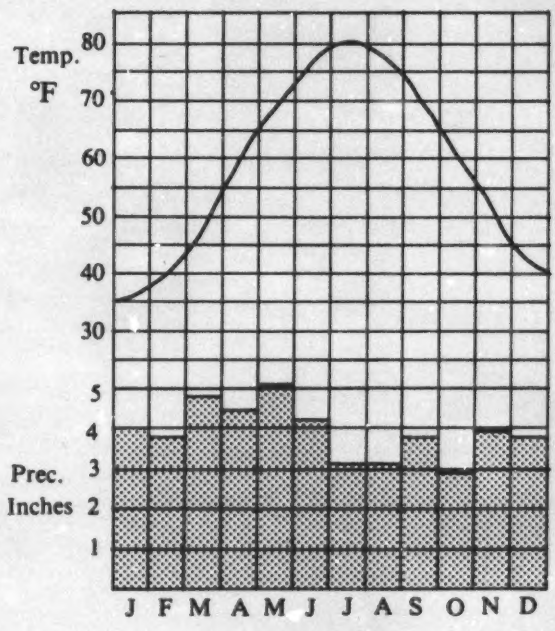
Climagraph Northern MO



Climagraph Ozarks MO



Climagraph Western MO



Climagraph S.E. Lowlands

Appendix 5

Fahrenheit-Centigrade Temperatures

°F	°C	°F	°C	°F	°C
0	-17.8	35	1.7	70	21.1
1	-17.2	36	2.2	71	21.7
2	-16.7	37	2.8	72	22.2
3	-16.1	38	3.3	73	22.7
4	-15.6	39	3.9	74	23.3
5	-15.0	40	4.4	75	23.9
6	-14.4	41	5.0	76	24.4
7	-13.9	42	5.6	77	25.0
8	-13.3	43	6.1	78	25.6
9	-12.8	44	6.7	79	26.1
10	-12.2	45	7.2	80	26.7
11	-11.7	46	7.8	81	27.2
12	-11.1	47	8.3	82	27.8
13	-10.5	48	8.9	83	28.3
14	-10.0	49	9.4	84	28.9
15	-9.4	50	10.0	85	29.4
16	-8.9	51	10.5	86	30.0
17	-8.3	52	11.1	87	30.6
18	-7.8	53	11.7	88	31.1
19	-7.2	54	12.2	89	31.7
20	-6.7	55	12.8	90	32.2
21	-6.1	56	13.3	91	32.8
22	-5.6	57	13.9	92	33.3
23	-5.0	58	14.4	93	33.9
24	-4.4	59	15.0	94	34.4
25	-3.9	60	15.6	95	35.0
26	-3.3	61	16.1	96	35.6
27	-2.8	62	16.7	97	36.1
28	-2.2	63	17.2	98	36.7
29	-1.7	64	17.8	99	37.2
30	-1.1	65	18.3	100	37.8
31	-0.6	66	18.9	101	38.3
32	0.0	67	19.4	102	38.9
33	0.6	68	20.0	103	39.4
34	1.1	69	20.6	104	40.0

Appendix 6

BEST Objectives Covered by this Instructional Unit

Reading/Language Arts

5. Use reference materials and sources to obtain information to solve personal problems.

6. Recognize the main idea and specific details contained in a written selection.

12. Follow a set of written directions.

13. Interpret information presented in graphic or pictorial manner.

15. Write with complete sentences, acceptable sentence structure, acceptable grammatical construction and correct spelling and punctuation.

16. Use reference materials and sources (including human sources) to obtain information to solve personal problems.

17. Recognize the main idea and specific details in an oral presentation.

21. Follow oral or written directions to complete a process.

Mathematics

7. Solve problems involving measures of time and temperatures.

8. Interpret information from charts, graphs, tables, maps and scale drawings.

10. Interpret simple probability and statistical statements relating to common situations such as weather reports and opinion polls.

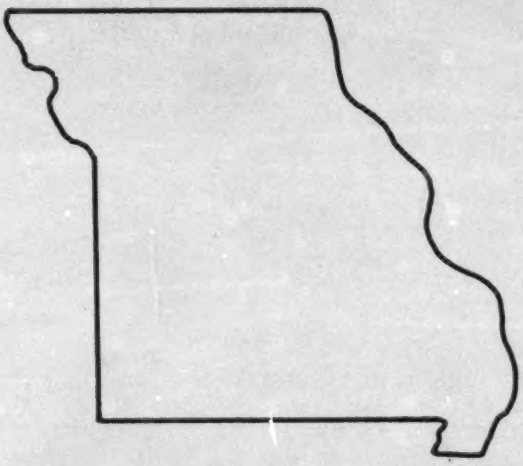
11. Determine the average for given numerical data.

Biogeography of Missouri

Test Questions

1. Define Biogeography.

2. Draw and label the four biogeographical regions of Missouri on map below.



3. Place the letter of the description below in the appropriate region above.
   A. Level to gently rolling uplands alternating with broken rocky ground on the hill slopes and in the valleys.
   B. Uplifted sedimentary plateau surrounding an igneous dome with most of the land in hill slopes containing many rock outcrops.
   C. Broad nearly level floodplain with many low terraces. Elevations, except for one prominent ridge, are between 250 and 350 feet.
   D. A dissected till plain covered with loess that is gently rolling with many high rounded hills and steep bluffs along the streams.

4. What factors determine the plant associations in a region?

5. What factors determine animal associations in a region?

MATCHING (from Glossary)

_____ 6. sediment deposited by glacial ice

_____ 7. soil with dark surface layer developed under grasses

_____ 8. highest point in Missouri

_____ 9. pertaining to material that is transported and deposited by running water

_____ 10. soil with light colored surface horizon developed under forest vegetation

_____ 11. wind-blown silt deposits

_____ 12. soils with limited soil development, commonly found on steep slopes

A. Alfisol

B. alluvial

C. Crowley's Ridge

D. Entisol

E. loess

F. Mollisol

G. Taum Sauk

H. till

I. Ultisol

13. Select any two biogeographical regions and complete the following chart.

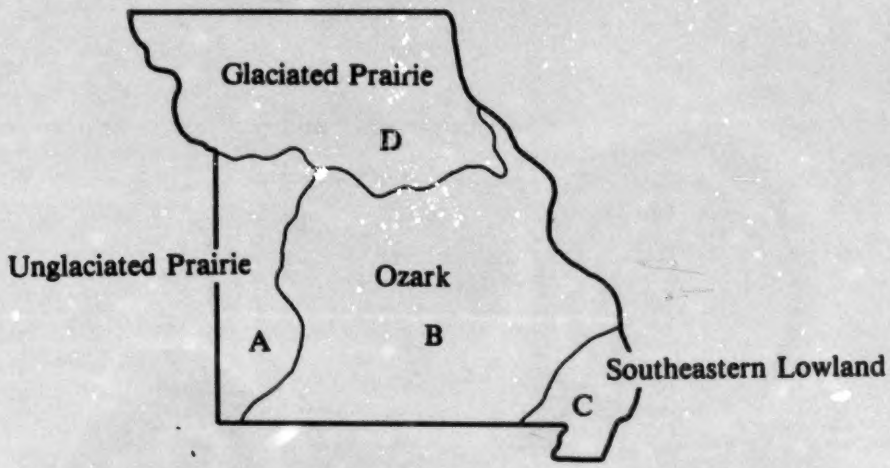
Region		
Average Annual Temperature		
Average Annual Precipitation		
Mammals (Name two)		
Birds (Name two)		
Fish (Name two)		
Plants (Name two)		

Biogeography of Missouri

Answer Key

1. The branch of geography that deals with the areal distribution of the organisms of the biosphere or a branch of biology that deals with the geographic distribution of plants and animals.

2.



3. See map above.
4. (Sun) soil, landforms, climate
5. Plant associations and water
6. G
7. E
8. F
9. B
10. A
11. D
12. C

13. (Key—any two of the following)

Region	Glaciated Prairie	Unglaciated Prairie	Ozark	Southeastern Lowland
Average Annual Temperature	53 °F	56 °F	56 °F	59 °F
Average Annual Precipitation	37"	37-43"	42"	46"
Mammals*	red fox, coyote, Franklin's ground squirrel, badger	coyote, red fox, black-tailed jack rabbit	gray fox, white-tailed deer, bobcat, chipmunk	beaver, swamp rabbit
Birds*	bobolink, song sparrow, ring-necked pheasant	prairie chicken, scissor-tailed flycatcher upland sandpiper, marsh hawk	pileated woodpecker, turkey, summer tanager, ovenbird, chuck-will's widow	mourning dove, black vulture, fish crow, red-shouldered hawk
Fish*	red & bigmouth shiners, catfishes, plains minnow, carp, river carpsucker	catfishes, fathead, minnows, orange-spotted sunfish	suckers, sunfish, bleeding shiner, northern studfish, rainbow darter	bowfin, blacktail shiner, pirate perch, dusky darter
Plants*	big & little bluestem, Indian grass, switchgrass, sideoats grama, white fur, black, shingle, and northern red, shagbark and bitternut hickory, walnut, pecan, elm, oak, cottonwood	bluestem, Indian grass, switchgrass, oak, hickory, elm, ash, cottonwood, prairie dropseed, June grass, purple top, slough grass, Canada & Virginia wild rye	white, black, post, scarlet, blackjack oaks, hickories, shortleaf pine	silver, red maples, green ash, hackberry, bald cypress, tupelo, American holly, willow oak, yellow poplar, swamp cottonwood

*Accept other species if appropriate.

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Conservation Education Consultants

District 1
Rodney J. Green
408 South Polk
Albany, MO 64402
816/726-3677

District 2
Hollis D. Crawford
Route 1, Box 21
Gibbs, MO 63540
816/332-7278

District 3
Neil W. Jenkins
1250 NE Tudor Road
Lee's Summit, MO 64063
816/524-6196

District 4
Charles D. Jordan
620 Hillcrest Drive
Knob Noster, MO 65336
816/563-3738

District 5
Education Consultant
P.O. Box 180
Jefferson City, MO 65102
314/751-4115

District 6
Larry Behrens
1040 3rd Street
Troy, Missouri 63379
314/528-6766

District 7
Harold W. Thiele
7414 Dalgren
St. Louis, MO 63123
314/842-3870

District 8
Jack C. Woodhead
Route 1, Box 88A
Carthage, MO 64836
417/358-1196

District 9
Wendell Jeffery
1039 E. Manchester
Springfield, MO 65807
417/882-1142

District 10
Education Consultant
Box 138
West Plains, MO 65775
417/256-7161

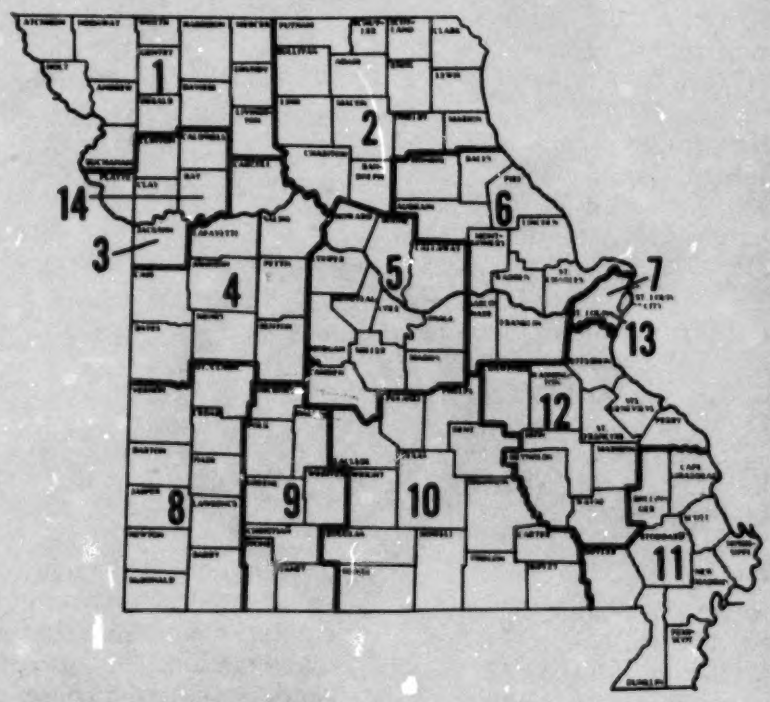
District 11
Gordon S. Griffin
806 Sherman Avenue
Charleston, MO 63834
314/683-6940

District 12
Barbara Sandhagen
#6 Westmount Drive
Farmington, MO 63640
314/756-5245

District 13
David B. Knisley
1409 San Miguel Lane
Fenton, MO 63026
314/225-3198

District 14
Jim Pyland
Route 3, Box 64D
Kearney, MO 64060
816/635-5160

Conservation Education Consultants will assist you in obtaining materials and scheduling equipment and films that are available from the Department of Conservation. They also offer workshops to provide training in conservation education.



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Outdoor Skills Specialists

Northwest Area
Louis F. Diebold
P.O. Box 26
Savannah, MO 64485
816/324-4672

Northeast Area
Wayne Martin
1710 E. McPherson
Kirksville, MO 63501
816/665-8075

St. Louis Area
Patti Redel
St. Louis Sub-Office
1221 South Brentwood Blvd.
St. Louis, MO 63117
314/726-6800

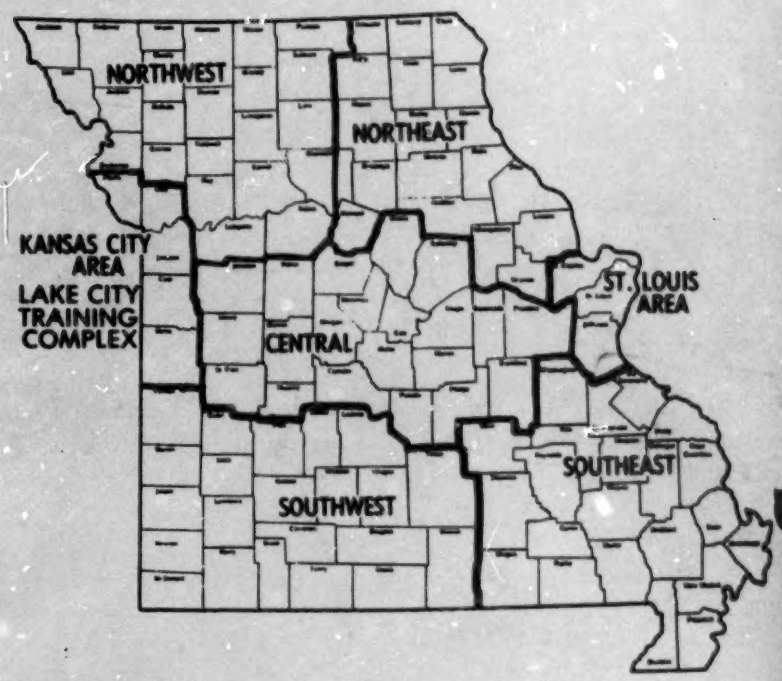
Southeast Area
Stephen J. Wilson
318 East Neal Street
Jackson, MO 63755
314/243-1143

Southwest Area
Richard Flint
406 W. Locust
Aurora, MO 65605
417/678-2445

Kansas City Area
Jeanne Marolf
300 N.W. 43rd St.
Kansas City, MO 64116
816/453-0546

Lake City Training Center and Range
Lloyd Williams
Kansas City Sub-Office
Brywood Shopping Center
8616 East 63rd Street
Kansas City, MO 64133
816/356-2280

Central Area
Robert D. Staton, Jr.
Rt. 1, Box 312
California, MO 65018
314/796-2669



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